D-31-12-4-8
DRAFT

WORK PLAN

FEASIBILITY STUDY OF ALTERNATIVES

KALAMAZOO RIVER PCB PROJECT
KALAMAZOO AND ALLEGAN COUNTIES, MICHIGAN

STATE OF MICHIGAN CONTRACT NO. 1611

NUS JOB NO. U311

DECEMBER 1984

NUS CORPORATION
A Halliburton Company

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SUBMITTED FOR NUS BY:

STEPHEN F. PEDERSEN, P.E.
PROJECT MANAGER

APPROVED:

G. A. SGRO
MANAGER,
MICHIGAN REGIONAL OFFICE

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1.0 INTRODUCTION

This section introduces the Work Plan for the Feasibility Study (FS) for the Kalamazoo River Project. The Work Plan is a planning document that outlines the scope of work required to further define the nature and extent of the PCBs in the Kalamazoo River and to determine the best method, or methods, to remediate significant adverse effects of PCBs on the fish population of the river. A brief description of the Michigan Environmental Response program is presented in Section 1.1 to provide the legislative background for the work to be performed.

This Work Plan has been prepared in response to a Request for Work Plan issued by the Michigan Department of Natural Resources (MDNR) under the State of Michigan Contract No. 1611 and received by NUS Corporation on October 23, 1984.

1.1 Legislative Background Superfund, the National Contingency Plan and the Michigan Environmental Response Act

Recognition of the adverse environmental impact of common waste disposal practices in the late 1960's and through the 1970's fostered concerted efforts in the 1980's to identify and remediate sites where the public health and the environment are threatened by uncontrolled hazardous wastes. Part of those efforts are embodied in the Federal Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), which is commonly known as "Superfund". CERCLA required the revision of Section 105 of the National Contingency Plan (NCP), which was first published as part of the Federal water pollution control program, and also required development of a National Priority List, which prioritized hazardous waste sites for subsequent remedial action. The final form of the NCP, published as 40 CFR Part 300, on July 16, 1982, provided methods and guidelines for identifying, ranking, investigating, evaluating, and remediating sites under the Superfund program. CERCLA also provide funds for the investigation of and response to abandoned hazardous waste sites.

Section 1 is an introduction, while Section 2 outlines the present understanding of the nature of the problem. Section 3 describes the technical approach that will be used in this study. Section 4 discusses the management of the project, while Section 5 includes costs and schedule. Resumes of key personnel are included in Appendix A, while Appendix B outlines the Quality Assurance procedure to be used for laboratory analyses.

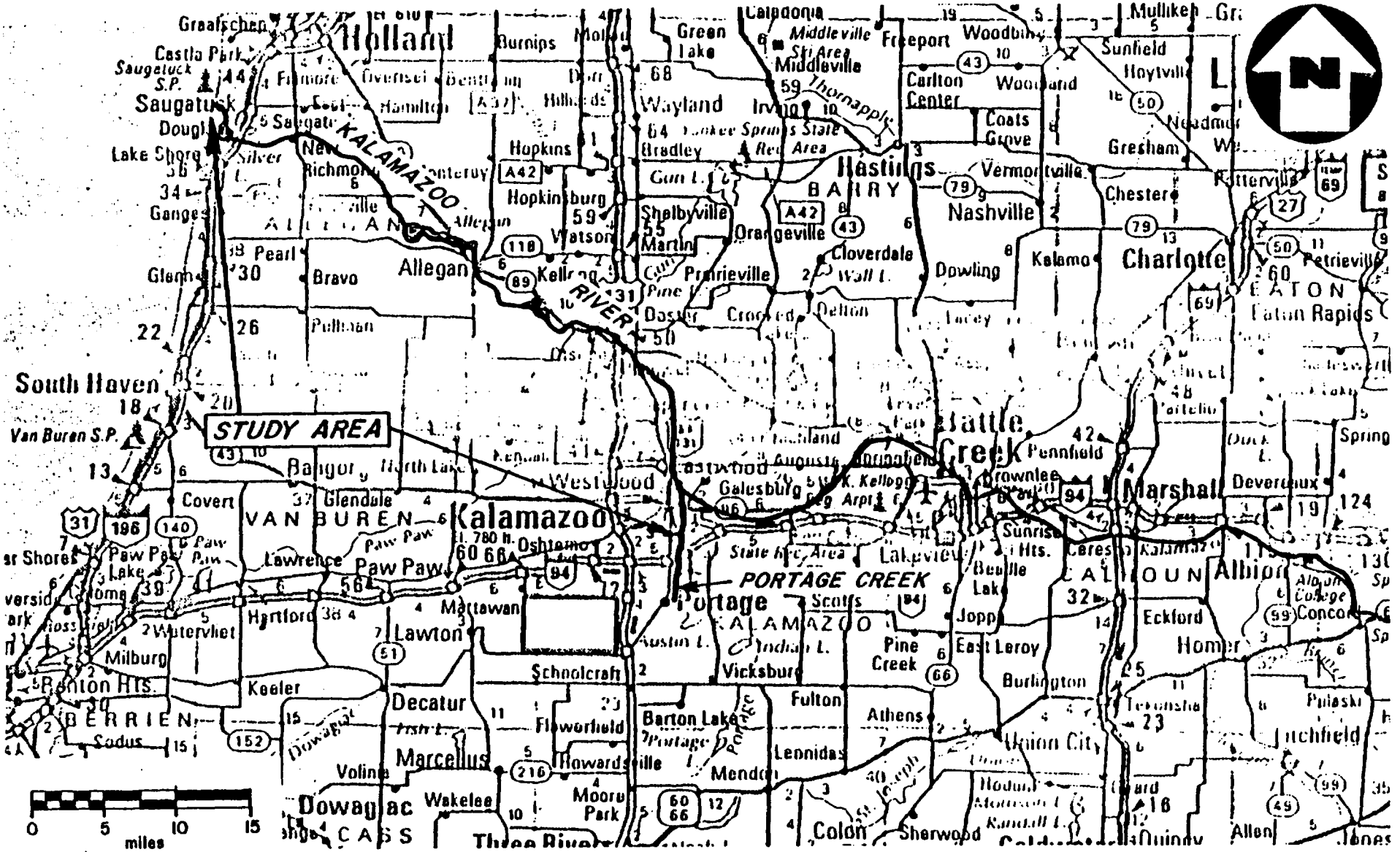

FIGURE 2-1

STUDY AREA
KALAMAZOO RIVER PCB's PROJECT

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3.0 TECHNICAL APPROACH

3.1 Introduction

PCB contamination has been identified in Portage Creek and the Kalamazoo River between the City of Kalamazoo and Lake Michigan. The primary impact of the PCB contamination is the elevated PCB concentration of fish in the Kalamazoo River and Portage Creek, and PCB contamination in the river sediments. Objectives of this Kalamazoo River PCB feasibility study are to identify the source of PCB contamination within the sediment deposits of the river, and to determine cost-effective and environmentally sound measures to reduce the PCB concentration in fish in the Kalamazoo River to less than 2 mg/kg.

The study will attempt to further identify the sources and distribution of PCB within the sediments along the river and to evaluate the effect of various management alternatives by the use of a mathematically-based water quality model. Literature reviews and field sampling will provide the mathematical model with sufficient data for development, calibration, and verification, before the model is used to evaluate the effectiveness of the remedial alternatives. Existing data will be collected and reviewed in order to reduce the amount of new data required to satisfy the need of the model. Values of coefficients associated with the governing equations used in the mathematical model will be determined through model calibration, if sufficient data are available, or literature reviews. The feasibility study will identify and evaluate appropriate remedial actions for the Kalamazoo River based on the available data and the results of the model prediction.

This section presents the tasks of the feasibility study for the Kalamazoo River PCBs Project. The tasks include the work plan preparation, data evaluation and collection, model development, alternatives development, results of field sampling and data analysis, evaluation of alternatives, and selection of the final alternatives.

water and sediment, sediment erosion and transport; and hydrology of the Kalamazoo River.

Task 3 - Model Development

A PCB-fate-and-distribution model developed by Limno-Tech, Inc. has been reviewed and selected for use in this study. This model combines the major physical processes affecting the transport and fate of PCB in water and sediment, with simplified methods to account for the temporal and spatial variability of the PCBs. It is appropriate to apply this model, or a variation thereof, to this study since the level of theoretical and analytical treatment is consistent with the intended use of the model as a planning tool and the data base currently available or expected to be collected. The modeling strategy of this project is to use the PCB model developed by Limno-Tech, Inc. to simulate the PCB transport and distribution in the water and sediment in the major river reaches and reservoirs. Other biological factors, such as fish food supply and weight and age of the fish are not currently incorporated into the model and will be assessed in more detail. PCB contributions from sediments behind drawndown reservoirs which cannot be adequately simulated by this model will be assumed to be point loadings to the river segments. The magnitude of the loadings will be estimated based on the existing sample data and special engineering analyses.

The simulated PCB concentrations in water and sediment will be converted into the PCB concentration in the food supply of the fish by using appropriate bio-concentration factors reported by EPA or in other literature sources. Thus, PCB concentrations in fish can be determined by taking into account the PCB concentration in the water and in the food supply of the fish, and the retention factor of PCBs in the fish species of interest. For the Kalamazoo, the species which will be used are carp and large mouth bass. The effects of fish age and weight will be considered based on a review of both the literature and the available data base for the Kalamazoo River.

- Removal of one or more of the privately-owned dams.
- Dredging of the study portion of the Kalamazoo River and Portage Creek.
- Dredging of Portage Creek only.
- Dredging of selection portions of the Kalamazoo River.
- Dredging of Lake Allegan.
- Dredging of the impoundments behind the privately owned dams.
- Stabilization of exposed sediments behind one or more MDNR owned dams.
- Removal of exposed sediments behind one or more MDNR owned dams.
- Isolation of highly contaminated areas.
- Relocation of highly contaminated areas to controlled areas in the immediate vicinity of the river.
- In-situ treatment techniques.

This list of alternatives will be modified, and selected items removed, added, combined, or otherwise altered based upon the findings of the investigative portion of the study and the model input needs.

Task 5 - Results of Field Sampling and Data Analysis

Application of the model on the specific site relies upon the adequacy of the model assumptions and sufficient model calibration and validation, as well as the availability of the objective of this task is to satisfy the deficiencies data base

be chosen after taking into account the relative effectiveness, impacts, potential gains or benefits, and the preferences of the community and the MDNR (as directed by the MDNR). A comprehensive cost estimate will be provided for each alternative recommended.

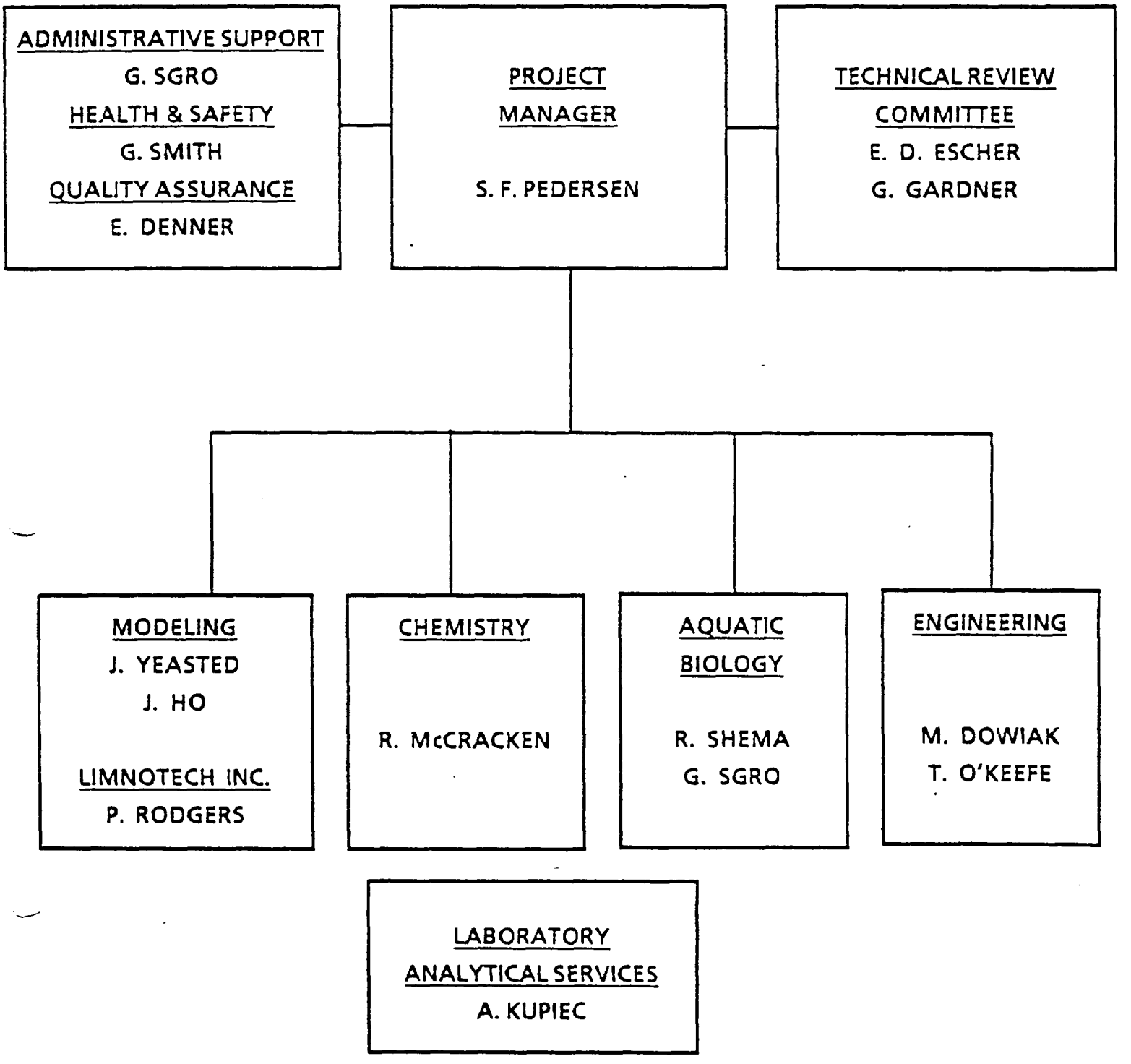


FIGURE 4-1

PROJECT ORGANIZATION AND PERSONNEL
KALAMAZOO RIVER PCB's PROJECT

7. General comments

8. Attachments
   - Weekly time logs

The progress summaries will be neatly handwritten on a standard form.

Monthly progress reports will include a compendium of the weekly summaries in regard to items 1, 2, 4, 5 and 7; a work projection based upon the entire following month; and a detailed financial accounting of the report period and projection for the following period. This accounting would be by major study plan task items and will include a breakdown by labor and other direct cost item.

4.3 Laboratory Program Coordination

In accordance with the requests of MDNR, NUS is prepared to complete analytical analyses support services for this assignment. Unit costs for these analytical services and an estimate of potential analysis requirements are provided in the budget section of this work plan.

4.4 Document Control

All data, documents, and information concerning the Kalamazoo River PCBs project assignment will be considered confidential and will not be released to anyone outside of the NUS or MDNR project teams without the written authorization of the MDNR Project and/or Contract Administrators. All documents and data will be indexed and assigned a file category number. A record of recipients will be maintained. The index will be updated on an as-needed basis, with copies being provided to all users. Duplicate copies of the file will be maintained in the NUS facilities in Lansing and in Pittsburgh.

TABLE 5-1

TASK HOURS
KALAMAZOO, MICHIGAN

Personnel	Task No. 1 Work Plan Preparation	Task No. 2 Data Collection	Task No. 3 Model Development	Task No. 4 Develop Alternatives	Task No. 5 New Data Evaluation	Task No. 6 Alternative Evaluation	Task No. 7 Rec. Alt./ Report	Project Management	Totals
Dowiak, M.	0	0	0	0	0	40	40	0	80
Gardner, G.	5	0	0	0	0	0	20	20	45
Ho, J.	30	100	200	20	10	180	60	0	600
McCracken, R.	0	0	0	0	30	0	0	0	30
McCutcheon, H.	30	0	0	0	0	0	0	0	30
O'Keefe, T.	0	40	0	80	0	80	80	0	280
Pedersen, S.	24	10	0	25	10	40	40	300	449
Sgro, G.	5	0	0	0	0	0	10	8	23
Shema, R.	0	0	0	0	20	20	10	0	50
Yeasted, J.	5	0	30	0	0	10	10	0	55
Inform. Process	10	0	0	0	0	0	40	0	50
Drafting	15	0	0	0	0	0	80	0	95
Task Totals - NUS	124	150	230	125	70	370	390	328	1787
Task Totals - Limno-Tech	0	0	700	0	0	0	0	0	700
GRAND TOTALS	124	150	930	125	70	370	390	328	2487

Footnote:

1. A breakdown of hours by study team member for Limno-Tech is provided in Attachment No. 2 of the Budget Estimate.

APPENDIX B

NUS CORPORATION
LABORATORY SERVICES DIVISION
QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

NUS CORPORATION
LABORATORY SERVICES DIVISION
QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The NUS Laboratory Services Division (LSD) is dedicated to performing its services in accordance with the highest attainable quality standards and thus performs all analyses according to accepted quality assurance (QA) practices and NUS' established QA programs and procedures.

It is more than professional pride mandating that analytical results be valid; all involved recognize that the results are the basis of decisions to construct new facilities, to modify plants, and to change treatment processes. Analytical results also substantiate effluent quality and pollution abatement.

Appreciating the importance of their function, the laboratories extend their responsibility beyond conforming to federal, state, and industrial regulations, codes, and standards to subjecting all work to technical reviews before results are released outside the corporation.

The laboratories' QA Program not only certifies the precision and accuracy of their analytical data, but also confirms by documentation all phases of sample handling, data acquisition and transfer, report preparation, and report review.

In addition, it provides for storage and retrieval of both samples and data. Because results may be challenged at any time through legal action and social pressures to abate pollution, retrieval of records and data is essential.

The Laboratories' QA program dictates that detailed instructions be available for performing all activities affecting the quality of analytical data. The program provides for appropriate management review and approval of all procedures including revisions to procedures, as well as control of procedures to ensure that laboratory personnel who require specific procedures have access to them. The LSD Procedures Manual is structured to address all elements of the LSD's Quality Assurance Program. The contents of the manual are described in the following paragraphs.

Sample Management, Data Review and Transfer

A computerized system is used for sample check-in, tracking of samples through the laboratory, assignment of laboratory analyses, and sample check-out. The system provides for management review of all laboratory data before issuance of client reports. The review is accomplished on two levels; review of raw data for each analysis, and review of the final results to check for consistency or agreement of the results between all parameters. The computer offers the advantage of fast retrieval of information.

Analytical Procedures

To ascertain that the laboratory analyses are performed using proper techniques, a section of the LSD Procedures Manual is devoted to laboratory methods. Each analyst is provided with a copy of all laboratory methods to be included in his copy of the manual. All methods are based on accepted government and industry standards. All laboratory methods contain the following information:

- Scope

  A description of the scope or applicability of the procedure.

- Principle

  A brief description of the steps to be taken and/or the theory involved in the laboratory analysis.

- Interferences

  A description of known interfering agents which would cause difficulty in performing the laboratory analysis or would lead to erroneous results.

- Apparatus

  A listing or description of equipment required to perform the laboratory analysis.

- Reagents

  A listing of the reagents required, a description of the steps involved in preparing the reagents and instructions on storage requirements and retention items.

- Procedure (Instructions)

  An enumeration of the sequence of activities to be followed. The topics include sample preparation or pretreatment, sample storage requirements, instrument set-up, standardization or calibration, sample analysis, calculations, and glassware cleaning procedures. The procedure includes any precautions, explanation, or clarifications as needed to properly perform the analysis. These include safety precautions, the frequency of standardization required, the acceptance criteria or procedures for determining the acceptability of standard curves, clarifications of special techniques critical to the analysis, and how the analyst determines the reliability of sample results based on the standard curves.

- Quality Control Requirements

  A listing of the Quality Control (QC) checks to be performed and the acceptance criteria used to evaluate the QC data.

Quality Control

The quality of analytical data is monitored through the use of the LSD's quality control procedures. The procedures specify what measures are to be taken to determine the validity of laboratory analyses. These include the analysis of method blanks, reagent blanks, daily standard checks, method duplicates, matrix spikes and surrogate spikes. Blanks are run along with the actual samples to check for possible contamination in the analysis procedure.

General QC procedures are described on the following pages. These procedures are used for inorganic analyses. QC information specific to organic analyses can be found in "Quality Control Procedures for Organic Analyses" which follows this section.

- Precision

  Precision refers to the reproducibility of results. At NUS labs these results are obtained from actual samples, not from reference standards. The samples selected cover a range of concentrations and a variety of interfering materials that are normally encountered by the analyst.

  Every tenth sample, or one sample in each day's run for a specific parameter, is determined in duplicate using different aliquots, when practical.

  From data generated by this procedure, control charts are constructed following the Shewhart approach modified by E. C. Robles, Jr., McClelland Air Force Base. The range between the duplicate samples is divided by the sum of the duplicate observations for 26 pairs. The control limits are calculated in the following equation.

$$\frac{\text{Observation 1} - \text{Observation 2}}{\text{Observation 1} + \text{Observation 2}} = x_i \text{ (absolute value)}$$

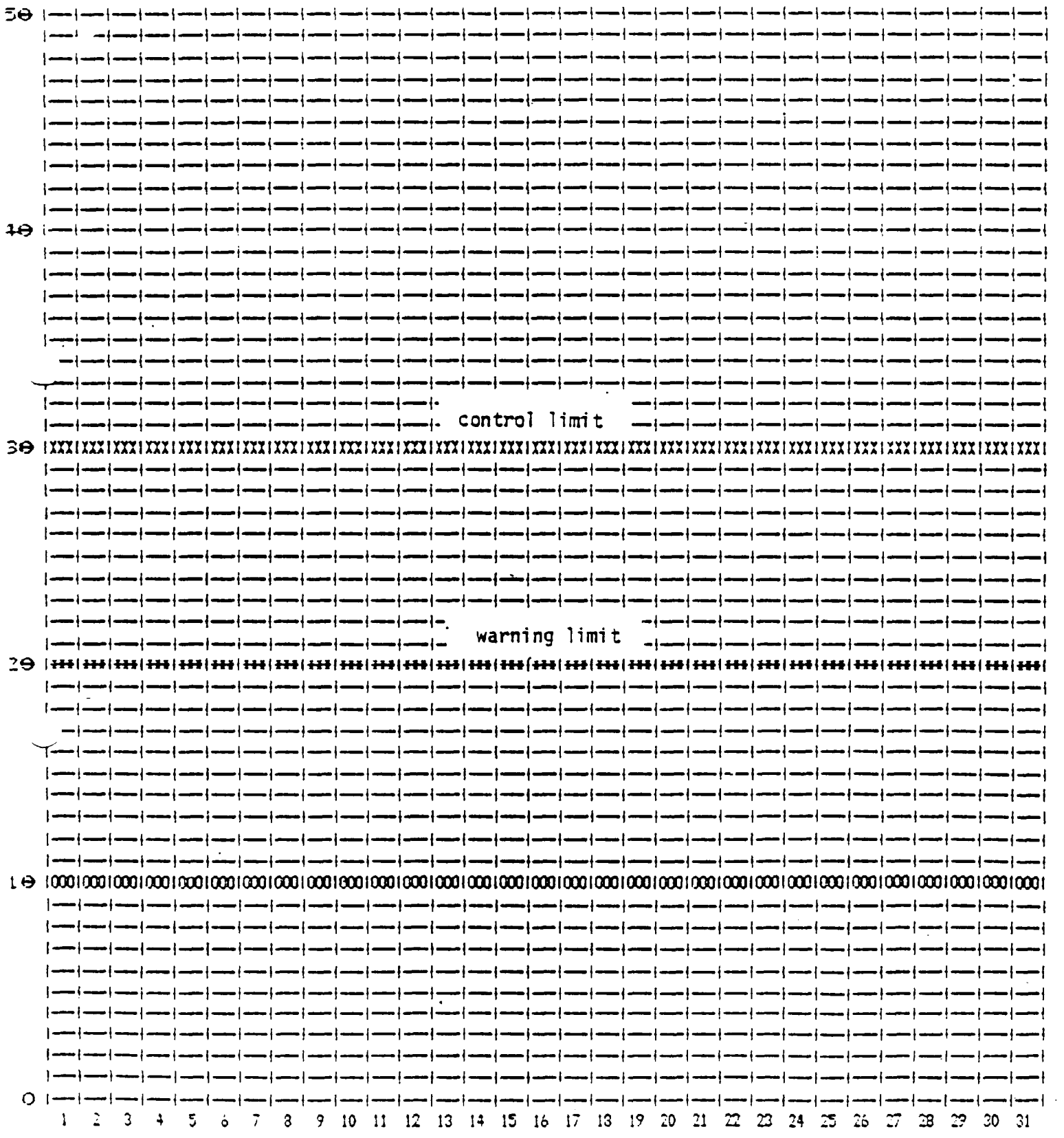
$$\text{Mean } (\bar{x}) = \frac{\sum_{i=1}^{26} x_i}{26}$$

$$\text{Standard Deviation } (\theta) = \sqrt{\frac{\sum_{i=1}^{26} (\bar{x} - x_i)^2}{25}}$$

2θ = Warning Limit
3θ = Control Limit

EST NAME ALUMINUM (A1)
EST NUMBER M010
NSTRUMENT 306
JPLICATES

DATE PREPARED: 08.17.83
DATE CALCULATED 08.01.83



θ = 0.024 (STANDARD DEVIATION)
2θ = 0.048 (WARNING LIMIT)
3θ = 0.072 (CONTROL LIMIT)
0.039 IS THE MEAN

AUGUST 1983
FIGURE 1

the absorptivity of a substance is a constant with respect to changes in concentration, i.e., absorbance is linear with concentration, and absorbance of various components in a mixture is additive.

Beer's law can be expressed as:

$$a = \frac{A}{bc}$$

a = absorptivity
$A = T$ absorbance ($\log_{10} \frac{1}{T}$)
b = cell thickness
c = concentration in weight per volume

In the Division laboratories, standardization of all spectrophotometric procedures is performed in the following manner. Four to ten solutions are prepared covering a range of concentrations of the desired constituent. An aliquot of each solution and an aliquot of solvent (solution blank) are treated according to the outlined procedure to be used for samples.

Absorbances (A's) versus the solvent are measured at optimum wavelength. The A's are corrected for the solution blank and absorptivity is calculated for each solution with c expressed in µg per liter. The standard deviation for absorptivities is obtained and, providing it is within the limits specified, a factor (F) is calculated as follows:

$$F = \frac{1}{\text{average } a}$$

The unknown concentration of a constituent, X, in a sample solution is calculated:

$$\mu gX/ml = F(A-A_1)\ (\frac{V_2}{V_1})$$

where A = absorbance of unknown

A_1 = absorbance of solution blank

V_1 = volume of sample

V_2 = final volume

If the absorptivities calculated for the standard solutions are not constant and indicate deviation from linearity, the corrected A's versus concentration in µgX/ml can be plotted on linear paper and a smooth curve drawn between points. The concentration of X in a sample solution is then determined directly from the curve. Every effort is made to select sizes that will produce A's on the steepest part of the curve.

For those methods in which a reproducible, stable color is formed, a complete standard curve is prepared every six months with each set of cells

QUALITY CONTROL PROCEDURES
FOR ORGANIC ANALYSES

Priority Pollutants

The quality control procedures used for the organic priority pollutant compounds follow the guidelines established in the Federal Register, December 3, 1979 and the Environmental Protection Agency publication The GC Screen. GC/MS Analysis of Organic Compounds, July 1983, revised in May 1984.

GC/MS Analysis
(Acid, Base-Neutral, and Volatile Organic (VOA) Fractions)

Instrument Calibration and Instrument and Column Performance Evaluation

The mass assignment and resolution of the mass spectrometer is calibrated using perfluorotributylamine (FC-43). After that, the system performance is evaluated by injecting 50 ng of decafluorotriphenyl phosphine (DFTPP) for acid and base-neutral analyses and 50 ng of bromofluorobenzene (BFB) for VOA analyses according to the requirements in EPA Methods 624 and 625. The ion abundance criteria specified in the methods must be met before any analyses are attempted. If difficulty is encountered in meeting the criteria for DFTPP or BFB, the mass spectrometer is tuned and re-evaluated until the requirements for DFTPP and BFB are met.

Included in the DFTPP standard mixture is pentachlorophenol, an acid compound, and benzidine, a base-neutral compound. These compounds are used to evaluate the GC column performance. The GC/MS operator must demonstrate the ability to detect, at the 50 nanogram level, either pentachlorophenol or benzidine, or both when acid and base-neutral analyses are performed simultaneously. The chromatograms are examined for tailing of these compounds. If the chromatograms indicate a problem, the column is treated before proceeding with standardization.

Standardization

Each day that analyses are performed, the instrument is standardized by analyzing a standard solution containing the compounds of interest. The initial standardization is verified every twelve hours until the analyses are completed.

Single-point calibrations are performed, and a response factor (RF) is determined each time the standardization is done. The response factor is determined by the internal standard (IS) method. Internal standards, which are deuterated compounds, are added to all standards as well as to all blanks and samples before injection into the GC/MS system. The standardization response factor is calculated as follows:

Base-neutral and acid blanks are analyzed as required. One liter of deionized water is extracted and analyzed to check for glassware and reagent contamination. Should sample analysis indicate possible contamination, the analysis of blanks is used to isolate the source of the problem.

Matrix Spike Duplicates

At a frequency of one sample in every twenty samples, matrix spike analyses are performed in duplicate for acids, base-neutrals, and VOAs. Matrix spikes are prepared by adding a known amount of standard to actual samples. For the base-neutral and acid fractions, two additional extractions are performed, and the extracts are then analyzed separately as routine samples. For the VOA fractions, two additional purge and trap concentrations are performed and analyzed separately as routine samples. The acceptance criteria for evaluating the spike recoveries are derived from the same publication used to evaluate surrogate recovery data.

Gas Chromatography Analyses (Pesticides and PCBs)

Standardization/Calibration

The external standard method is used to calibrate the gas chromatograph when performing pesticide or PCB analyses in sediment or water matrices. Daily or each time the instrument is used, whichever is more frequent, a one-point calibration is performed. Separate standards are prepared for the priority pollutant pesticides analyses and for PCB analyses. The standard peak areas are calculated, and sample peak areas are compared to that of the standard.

For analysis of PCBs in oil, an internal standard is added before sample injection. The internal standard areas are monitored to check for instrument drift, and the response factor is used to calculate the concentration of the PCBs in the samples.

Surrogate Spikes

A surrogate spiking compound, dibutylchlorendate, is added to samples, blanks, and standards for analyses of priority pollutant pesticides. As is done when base-neutral and acid analyses are performed, the surrogate is added before extraction to point out extraction problems and sample matrix interferences. The acceptance criteria for the recovery of the surrogate are found in The GC Screen GC/MS Analysis of Organics Compounds.

Blanks

With every set of twenty samples for PCBs in sediment or priority pollutant pesticides, method blanks are prepared and analyzed using deionized water. The blanks are used to monitor glassware or reagent contamination.

The solvent used to prepare oil samples for PCB analyses is checked with every set of ten samples. The solvent is also used to check the system after samples with high PCB content have been injected into the GC.

the samples. Separate standards are prepared for the pesticides, herbicides, and THMs.

Duplicates

At a frequency of one sample in every ten, duplicate injections of the sample extracts for pesticides and herbicides are made to check for consistency in the analyst's injection techniques as well as for possible changes in instrument conditions. For THM analyses, the actual sample (not an extract) is introduced into the purge and trap device in duplicate. From the duplicate results, precision (x_j) is calculated by dividing the absolute value of the range between the duplicate results by the absolute value of the sum of the two results. When sufficient data is available, control limits are determined using the same procedure described earlier for PCB analyses in oil.

Blanks

With every set of twenty samples extracted for either pesticides or herbicides, method blanks, which consist of deionized water carried through the entire procedure, are analyzed. For THM analyses, one deionized water blank per day is analyzed in the same manner as the samples.

Percent Recovery

At a frequency of one sample in every twenty for either drinking water pesticides or herbicides, deionized water is spiked with a standard to determine the percent recovery of the method. Acceptable ranges are established by calculating $\pm$ one standard deviation from the mean percentage of 26 recoveries.